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DELAWARE RIVER BASIN
NORTH BRANCH RANCOCAS CREEK
BURLINGTON COUNTY
NEW JERSEY

SMITHVILLE DAM
NJ 00043

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

DEPARTMENT OF THE ARMY
Philadelphia District
Corps of Engineers
Philadelphia, Pennsylvania

REPT. NO: DAEN/NAP-53842/NJ 00043-81/01

JULY 1981

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Smithville Dam, N.J.
Spillways

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report. → next page

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DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE—2 D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO
NAPEN-N

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, New Jersey 08621

24 AUG 1981

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Smithville Dam in Burlington County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Smithville Dam, a high hazard potential structure, is judged to be in fair overall condition. The dam's spillway is considered inadequate because a flow equivalent to 9 percent of the Spillway Design Flood - SDF - would cause the dam to be overtopped. (The SDF, in this instance, is one half of the Probable Maximum Flood). The decision to consider the spillway "inadequate" instead of "seriously inadequate" is based on the determination that dam failure resulting from overtopping would not significantly increase the hazard to loss of life downstream from the dam from that which would exist just before overtopping failure. To ensure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway is inadequate but more detailed hydraulic and hydrologic studies are recommended only in connection with studies of other dams in the same drainage system and with structural stability investigations outlined below.

b. Within one year from the date of approval of this report the owner should engage a qualified professional consultant to investigate the structural stability including consideration of the effect of overtopping of the dam. As a result of the investigation, the need for and type of remedial measures should be determined and then implemented.

c. Within six months from the date of approval of this report, the following remedial actions should be initiated:

NAPEN-N
Honorable Brendan T. Byrne

(1) The steel sheet piling abutments at each end of the dam should be renovated by cleaning, painting and replacement of the wales.

(2) The stabilization of the stream banks downstream from the dam should be renovated.

d. The owner of the dam should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam within one year from the date of approval of this report.

e. The existing emergency action plan and warning system should be put in writing within six months from the date of approval of this report and should include actions to be taken by the owner to minimize the downstream effects of an emergency at the dam.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman Forsythe of the Sixth District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Inspection Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,

ROGER L. BALDWIN
Lieutenant Colonel, Corps of Engineers
Commander and District Engineer

1 Incl
As stated

Copies furnished:
Mr. Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

Mr. John O'Dowd, Acting Chief
Bureau of Flood Plain Regulation
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

SMITHVILLE DAM (NJ00043)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 6 January 1981 by Storch Engineers, under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Smithville Dam, a high hazard potential structure, is judged to be in fair overall condition. The dam's spillway is considered inadequate because a flow equivalent to 9 percent of the Spillway Design Flood - SDF - would cause the dam to be overtopped. (The SDF, in this instance, is one half of the Probable Maximum Flood). The decision to consider the spillway "inadequate" instead of "seriously inadequate" is based on the determination that dam failure resulting from overtopping would not significantly increase the hazard to loss of life downstream from the dam from that which would exist just before overtopping failure. To ensure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway is inadequate but more detailed hydraulic and hydrologic studies are recommended only in connection with studies of other dams in the same drainage system and with structural stability investigations outlined below.

b. Within one year from the date of approval of this report the owner should engage a qualified professional consultant to investigate the structural stability including consideration of the effect of overtopping of the dam. As a result of the investigation, the need for and type of remedial measures should be determined and then implemented.

c. Within six months from the date of approval of this report, the following remedial actions should be initiated:

(1) The steel sheet piling abutments at each end of the dam should be renovated by cleaning, painting and replacement of the wales.

(2) The stabilization of the stream banks downstream from the dam should be renovated.

d. The owner of the dam should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam within one year from the date of approval of this report.

e. The existing emergency action plan and warning system should be put in writing within six months from the date of approval of this report and should include actions to be taken by the owner to minimize the downstream effects of an emergency at the dam.

APPROVED: Roger L. Baldwin

ROGER L. BALDWIN
Lieutenant Colonel, Corps of Engineers
Commander and District Engineer

DATE: 24 Aug 81

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Smithville Dam, NJ00043
State Located:	New Jersey
County Located:	Burlington
Drainage Basin:	Delaware
Stream:	North Branch Rancocas Creek
Date of Inspection:	January 6, 1981

Assessment of General Condition of Dam

Based on visual inspection, past operational performance and Phase I engineering analyses, Smithville Dam, a high hazard potential structure, is assessed as being in fair overall condition.

Hydraulic and hydrologic analyses indicate that the spillway is inadequate. Discharge capacity of the spillway is not sufficient to pass the designated spillway design flood (SDF) without an overtopping of the dam (The SDF for Smithville Dam is equal to one-half the probable maximum flood.) The spillway is capable of passing approximately 4 percent of the probable maximum flood or 8 percent of the SDF. However, more detailed hydraulic and hydrologic studies are recommended only in connection with studies of other dams in the same drainage system and with structural stability investigations outlined below.

The owner should continue to employ the surveillance and emergency action plan currently in use. In the future, the plan should be reviewed and, after any necessary revisions, incorporated into a formal written plan.

In light of past failures of the dam and the recommendation in 1936 to drive significantly longer steel sheet piling, the structural stability of the dam should be investigated in the future by a professional engineer

experienced in the design and construction of dams. The investigation should include consideration of the effects of overtopping during the SDF on the stability of the dam and adjacent stream banks. As a result of the investigation, the need for and type of remedial measures should be determined and then implemented.

In addition, it is recommended that the following remedial measures be undertaken in the near future:

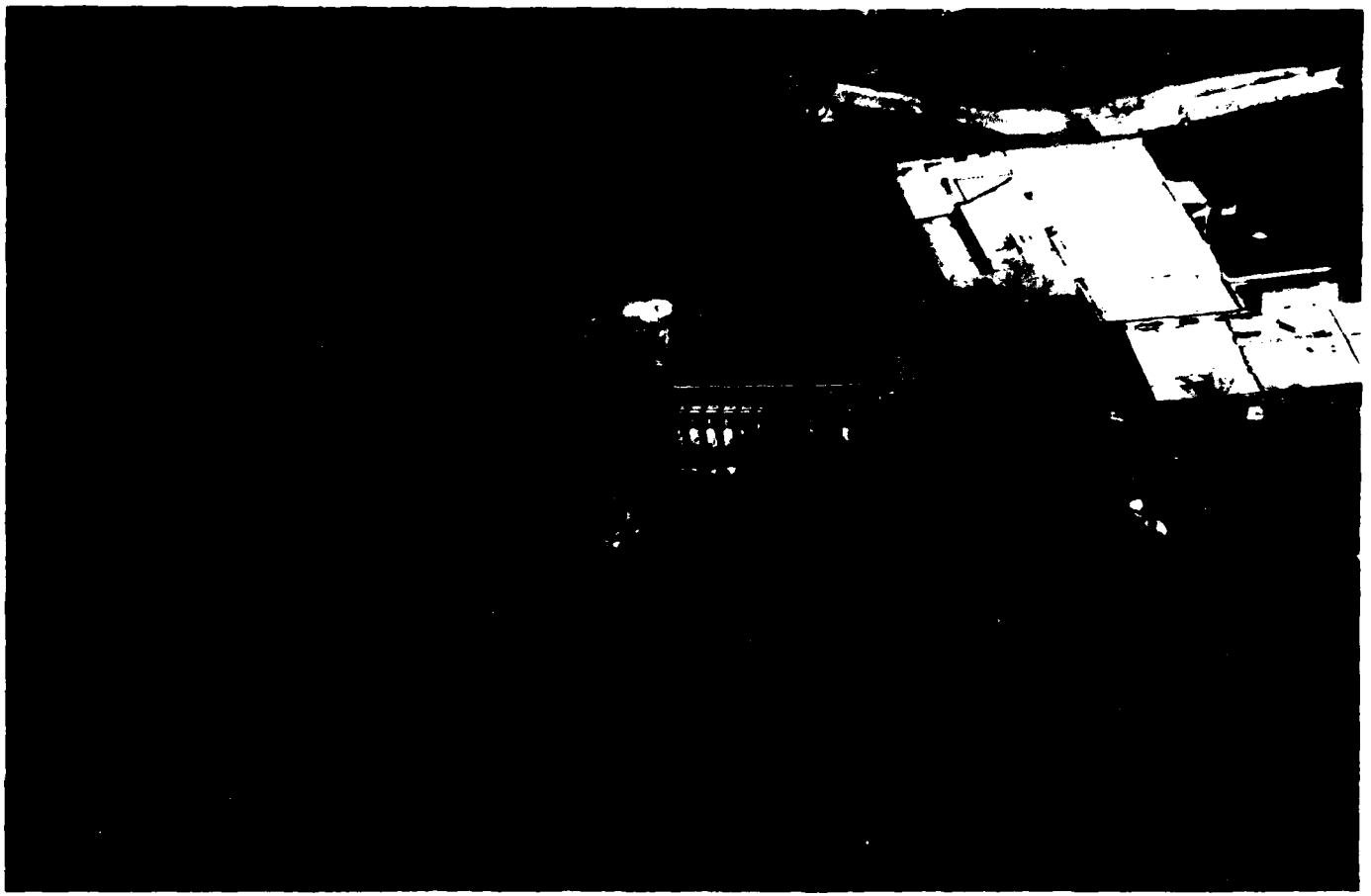
1) The steel sheet piling abutments at each end of the dam should be renovated by cleaning, painting and replacement of the wales.

2) The stabilization of the stream banks downstream from the dam should be renovated.

In the future, the owner of the dam should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam.

Richard J. McDermott, P.E.

John E. Gribbin, P.E.



OVERVIEW - SMITHVILLE DAM

31 JANUARY 1981

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that the unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydraulic and hydrologic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydraulic and hydrologic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

SMITHVILLE DAM, I.D. NJ00043

SECTION 1: PROJECT INFORMATION

1.1 General

a. Authority

Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the Unitied States. The Division of Water Resources of New Jersey Department of Environmental Protection (NJDEP) in cooperation with the Philadelphia District of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the State of New Jersey. Storch Engineers has been retained by the NJDEP to inspect and report on a selected group of these dams. The NJDEP is under agreement with the Philadelphia District of the Corps of Engineers.

b. Purpose of Inspection

The visual inspection of Smithville Dam was made on January 6, 1981. The purpose of the inspection was to make a general assessment of the structural integrity and operational adequacy of the dam structure and its appurtenances.

1.2 Description of Project

a. Description

Smithville Dam is a run-of-the river dam consisting of a series of twelve slide gates in a timber frame constructed across the North Branch Rancocas Creek. Steel sheet piling at each end serves as abutments and also as slope stabilization along the sides of the stream.

The elevation of the crest of the dam is 22.0 National Geodetic Vertical Datum (N.G.V.D.) while that of the top of the gates when closed is 18.6. The downstream channel bed elevation is 12.0. The overall length of dam is 60 feet and its height is 10.0 feet.

b. Location

Smithville Dam is located in the Township of Eastampton, Burlington County, New Jersey. Constructed across North Branch, Rancocas Creek, the dam impounds that stream as well as Smithville Lake which is located adjacent to the dam with intake immediately upstream. Principal access is by local roads in Smithville approximately one mile west of N.J. Route 206.

c. Size and Hazard Classification

The dam is classified in accordance with criteria presented in "Recommended Guidelines for Safety Inspection of Dams" published by the U.S. Army Corps of Engineers. Size categories consist of Small, Intermediate and Large while hazard categories are designated as Low, Significant and High.

Size Classification: Smithville Dam is classified as "Small" size since its maximum storage volume is 244 acre-feet (which is less than 1000 acre-feet) and its height is 10.0 feet (which is less than 40 feet).

Hazard Classification: Visual inspection of the downstream flood plain of the dam indicates that failure of the dam would inundate several dwellings located within 1 mile of the dam. Loss of more than a few lives is possible. In addition, dam failure during a storm equivalent to the SDF could cause property damage and inundation of dwellings located in Mount Holly approximately 2 miles from the dam. Accordingly, Smithville Dam is classified as "High" hazard.

d. Ownership

Smithville Dam is owned by the County of Burlington, R.D. #2, Maple Avenue, Mount Holly, New Jersey 08060.

e. Purpose of Dam

The purpose of the dam is the impoundment of a lake and stream used for recreation. During the summer months the lake is used as a municipal swimming facility.

f. Design and Construction History

The original Smithville Dam reportedly was constructed around 1780 for the purpose of supplying water to a nearby mill. The dam has been repaired or reconstructed on numerous occasions since the orginal construction. Dates of repair or reconstruction include 1934, 1937, 1941, 1953, 1969 and most recently 1980.

The dam repair of 1934 was performed in accordance with plans approved by the New Jersey State Water Policy Commission and was completed on September 24, 1934. The repair was accomplished by the H.B. Smith Machine Co., then owners of the dam and adjacent mill, for which the dam supplied water power. The dam repair included repair of the timber head gates which had failed on July 19, 1933. The information concerning the repair is presently on file with the NJDEP for Dam Permit #222.

On June 6, 1937, the dam structure failed in the vicinity of the junction of the right abutment and right end of the gate structure thereby causing failure of the right side banks. The necessary repairs were made in accordance with drawings entitled, "Proposed Repair of Smithville Dam," dated July 1937 prepared by a Mr. Willets of the H.B. Smith Machine Co. Mr. G.W. Branin of Vincentown was contracted to complete the proposed work. The H.B. Smith Machine Co. was informed in July, 1937, by the New Jersey State Water Policy Commission (NJSWPC) that the proposed repairs, as shown on the above noted drawings had been approved as additional work under Dam Permit #222 issued September 13, 1933. An NJSWPC inspection of September 22, 1937 revealed that the repair had proved unsuccessful due to the insufficient length of the sheet piling.

In 1938, the Federal Government approved a grant under the auspices of the WPA for the construction of a new dam at Smithville. Plans entitled, "Plans for Smithville Dam," dated February 1939 were then prepared by Mr. E.K. Bryant, Engineer, Township of Eastampton. The plans were approved and Dam Permit #329 was issued March 8, 1939 to begin construction. Construction began on February 2, 1940 and was completed on December 8, 1941. Reportedly, during construction of the new dam continual erosion of the right side bank resulted in several field construction revisions.

Reportedly, in 1953, the dam again failed. Designs were then prepared and supervised by the Bureau of Navigation. Plans entitled "Plan of Proposed Repairs to Existing Smithville Dam," dated September 1953 were approved on October 1, 1953 together with a set of specifications. Construction was completed on September 23, 1954 under Dam Permit #427 as approved by the NJSWPC.

On July 13, 1955, permission was given by the State Water Policy and Supply Council to install head gates to raise the water level. These gates would be closed from April 15 to October 15 annually. Plans were approved October 1953. A paid dam keeper was reportedly employed by the Township of Eastampton on June 29, 1955.

Reportedly, in June 1957, a leak was observed through the old creosoted sheet piling at the right end of the spillway. A considerable amount of soil had washed out. It is not known if any action was taken to repair the washout and leakage.

On November 16, 1965, the Township of Eastampton by way of letter from the Township Engineer requested that an inspection of the dam be made by the New Jersey Division of Water Policy and Supply. The inspection performed on December 3, 1965 revealed that 8 of the 12 flood gates were inoperable due to broken or missing cables, but structurally the dam was assessed as being in fairly good condition. It was also observed that the timber bulkhead on both the north and south bank immediately downstream from the spillway were found to be in poor and deteriorated condition. The Township of Eastampton was then ordered by the New Jersey Division of Water Policy and Supply to immediately take the necessary action to repair the dam completely. Reportedly, it was the opinion of the NJDWPS that if the flood gates had been properly maintained the damage to the embankments would not have occurred. The Town then began

to search for possible funds. The gates were ordered to be maintained in an open position by March 25, 1968 by order of the NJDWPS due to additional damage sustained by flooding and ice movement.

On December 12, 1969, repair drawings by Richard A. Alaimo Associates dated October 1968, entitled "Proposed Bulkhead Replacement" were approved under Dam Permit #472. Construction began in April 1969 which consisted of the removal of twelve old gates and their replacement with new timber gates. Steel sheet pilings were driven to function as bulkhead along the banks of the creek in the area close to the gates. It is not known when this construction was completed.

In 1980, the twelve timber slide gates were removed and replaced with wheel-operated aluminum slide gates by the County of Burlington. The new gates were installed in accordance with specifications and plans entitled, "Replacement of Flood gates - Smithville Dam," dated February 11, 1980, prepared by the Burlington County Engineering Department. These plans are on file with the Burlington County Engineering Department.

G. Normal Operation Procedure

Maintenance of Smithville Dam reportedly is performed by the Burlington County Highway Department. Reportedly, normal repairs consist of replacement of rotted timbers and cleaning of debris.

Reportedly, the North Branch of the Rancocas Creek is maintained at its normal stream level during the winter months, between November and April, when the flood gates are completedly opened. The floodgates are closed during the summer months when the impoundment and nearby lake are used for recreation.

1.3 Pertinent Data

a.	Drainage Area	132 square miles
b.	Maximum flood at damsite	1450 cfs (September 1938)
	Outlet works at pool elevation	N.A.
	Spillway capacity at top of dam	1062 cfs
c.	Elevation (N.G.V.D.)	
	Top of dam	22.0
	Maximum pool-design surcharge	26.2
	Primary spillway crest	18.6
	Stream bed at toe of dam	12.0
	Maximum tailwater	26 (Estimated)
d.	Reservoir	
	Length of maximum pool	N.A.
	Length of recreation pool	N.A.
e.	Storage (Acre-feet)	
	Recreation pool	65
	Design surcharge	649
	Top of dam	244
f.	Reservoir Surface (acres)	
	Top of dam	83 (Estimated)
	Maximum pool - design surcharge	116 (Estimated)
	Recreation pool	36.7

g. Dam

Type	Timber frame and pile
Length	60 feet
Height	10.0 feet
Sideslopes - Upstream	N.A.
- Downstream	N.A.
Zoning	N.A.
Impervious core	N.A.
Cutoff	Unknown
Grout curtain	Unknown

h. Diversion and Regulating Tunnel — N.A.

i. Spillway

Type	Sharp-Crested Weir
Length of primary weir	51 feet
Primary crest elevation	18.6
Gates	Metal Slide Gates Comprise Primary Weir
Upstream channel	Natural Stream
Downstream channel	Natural Stream

j. Regulating Outlet

Twelve (12) wheel operated metal slide gates.

SECTION 2: ENGINEERING DATA

2.1 Design

No plans or calculations pertaining to the original construction of the dam could be obtained. Information relating to the 1934, 1937, 1953, 1955, 1957 and 1969 repairs and reconstructions of the dam are available in the files of the NJDEP. Information relating to the installation of the new flood gates in 1980 are on file with the Burlington County Engineering Department.

The dam reconstructed in 1941 was based upon a design capacity of 1012 cfs at the top of the dam, the same design capacity as the old dam built in 1934 and also the same design capacity as Mill Dam, located downstream at Mt. Holly. According to the information available in the NJDEP files since both Mill Dam and Smithville Dam are inundated by tailwater during maximum flood flows, it was decided to use the 1934 design. It was thought a spillway of greater capacity would increase the possibility of flood damage downstream at Mt. Holly.

2.2 Construction

No data or reports pertaining to the original construction of the dam are available. Numerous inspection reports are on file with the NJDEP with exception of the repair performed in 1957 and the most recent renovations of 1968 and 1980.

2.3 Operation

Reportedly, no maintenance reports are on file with the County of Burlington. No data pertaining to operations are available.

2.4 Evaluation

a. Availability

Available engineering data is limited to that which is on file with the NJDEP, Division of Water Resources and the Burlington County Engineering Department. These files contain drawings, correspondence, hydraulic and hydrologic calculations, inspection reports, samples of test borings, applications and permits relating to the various repairs and reconstructions.

b. Adequacy

Available engineering data pertaining to Smithville Dam is of significant assistance to the performance of a Phase I evaluation. A list of absent information is included in paragraph 7.1.b.

c. Validity

The available hydraulic analyses appear to be valid with respect to engineering practice generally accepted in 1941. However, they are not valid according to analytic procedures developed by the Corps of Engineers for the present inspection and assessment program.

Although spillway discharge rates are in close agreement with values computed in connection with this Phase I Report, the design flood used in 1953 is not in conformance with the presently utilized SDF.

Hydraulic and hydrologic calculations indicate that during a storm equivalent to the SDF, Smithville Dam would be submerged by tailwater. Furthermore, the dam has very little flood attenuation effect during severe storm events. Therefore, increasing spillway capacity may not increase the possibility of flood damage downstream at Mt. Holly as assumed during previous design analyses.

SECTION 3: VISUAL INSPECTION

3.1 Findings

a. General

The inspection of Smithville Dam was performed on January 6, 1981 by staff members of Storch Engineers. A copy of the visual inspection check list is contained in Appendix 1. The following procedures were employed for the inspection:

1) The embankment of the dam, appurtenant structures and adjacent areas were examined.
2) The embankment and accessible appurtenant structures were measured and key elevations determined by surveyor's level.
3) The embankment, appurtenant structures and adjacent areas were photographed.
4) The downstream flood plain was toured to evaluate downstream development and restricting structures.

b. Dam

At the time of inspection one of the slide gates was in its "up" position and the river was discharging through that one gate.

The downstream apron appeared to be concrete with timber piles at its downstream end on which the timber frames rest. The timbers bracing the frames for the gates and the walkways appeared to be sound and in generally satisfactory condition. They have all been treated for rot.

The steel sheet pilings along the right side of the river were significantly rusted with scales peeling off. However, they appeared to be generally sound. The steel cap along the top

of the sheet piling along both sides of the dam was in satisfactory condition. The steel sheet pilings on the left side of the dam appeared to be in satisfactory condition. The steel wales on both sides were rusted and in deteriorated condition.

c. Appurtenant Structures

The river bank downstream from the dam was stabilized on both sides by riprap composed of concrete. The left concrete stabilization appeared to be undermined. Further down on the right side, large pieces of concrete were serving as riprap. In general the stabilization did not appear to be to be satisfactory and should be renovated. The banks of the river upstream from the dam were not stabilized and the right bank showed evidence of erosion. There was a chain link fence at both ends of the dam apparently to prevent trespassing. The fence appeared to be relatively recent and in satisfactory condition. Barbed wires at the ends of the fence that protrude over the river have been cut. A flood light atop a telephone pole at the right end of the dam, which appeared to be a mercury vapor type of flood light, serves to illuminate the dam at night. Reportedly, the light is activated every day by photo cell.

The junction between the steel sheet piling on the right side of the dam and the concrete bank stabilization appeared to be generally sound.

Concrete surface drain swales adjacent to the steel sheet pile abutments appeared to be in satisfactory condition.

c. Reservoir Area

The reservoir area is formed by the upstream portion of the North Branch of the Rancocas Creek impounded by the dam. It has banks similar to that of the downstream section. The

reservoir (stream) shores are wooded with banks approximately two feet high. The reservoir area then extends on a broad flat floodplain approximately 200 feet wide on the left side and approximately 400 feet wide on the right side. A machine shop situated in an old brick building is located immediately upstream of the dam on the left shore. The first floor elevation is approximately three feet above the water level at the time of inspection.

d. Downstream Channel

The downstream channel is a shallow, meandering river called the North Branch of the Rancocas Creek. It makes a sharp bend to the right about 200 feet downstream from the dam. It has banks approximately three to four feet high and wooded terrain on each side, comprising the floodplain, which extends approximately 200 feet to the left and 400 feet to the right.

There is a small white house approximately 300 to 400 feet downstream from the dam on the left side of the river in the area where the river makes its right hand bend. Further downstream, within one mile of the dam, several dwellings are located along the stream. Approximately two miles downstream, Mill Dam and the Township of Mt. Holly are located.

SECTION 4: OPERATIONAL PROCEDURES

4.1 Procedures

The level of water in Rancocas Creek is regulated by discharge through the twelve gates which span the river forming Smithville Dam. The gates can be used to lower the river level or to augment the discharge capacity of the spillway. Normally the gates are opened during the winter months in an attempt to prevent ice damage and are closed during the summer for recreational purposes. However, as a result of the drought during the past two years, all of the gates have been maintained in a closed position except during periods of heavy rain when the gates are opened at the direction of the Burlington County Civil Defense Coordinator.

4.2 Maintenance of the Dam

Reportedly, the dam is maintained on an "as needed" basis by the Burlington County Highway Department.

4.3 Maintenance of Operating Facilities

Reportedly, the operating facilities are inspected on a daily basis by the Burlington County Civil Defense Coordinator or his designee who in turn directs the Burlington County Highway Department to perform any necessary repairs including the cleaning of debris. Reportedly, during the past ten years the spillway gates have been the object of frequent vandalism. Therefore, a chainlink fence was installed for protection. In addition, a photoelectric floodlight has been installed to deter vandalism and is used during night time debris cleaning and gate maintenance operations.

4.4 Description of Warning and Operational System

Reportedly an informal but effective warning system is in effect along the entire length of the North Branch of the Rancocas Creek under the auspices of the Burlington County Civil Defense Coordinator. The participating communities include the Township of Mt. Holly (Mill Dam), Eastampton Township (Smithville Dam), Pemberton Boro (Spill Dam), and Pemberton Township (Mirror Lake Dam). During periods of heavy rain the level of water in the North Branch of the Rancocas Creek is monitored visually by the Burlington County Civil Defense which coordinates the work forces necessary to augment and diminish the discharge capacities at the respective dams including Smithville Dam.

Reportedly, the Burlington County Civil Defense monitors the weather by radio during periods of expected precipitation on a 24-hour basis. Reportedly, the spillway gates are opened on a staggered basis, beginning with most downstream dam (Mt. Holly-Mill Dam) and then proceding upstream at time intervals determined by the Burlington County Civil Defense. Normally, the gates are opened when the chance of rain is forecast between 50 and 100 percent. As the possibility for the chance of rain decreases the gates are closed unless visual reports necessitate other action. As a safety precaution no worker is permitted to operate the metal outlet mechanisms during periods of lightning or thunder.

Reportedly, the warning system and procedures outlined above has proven through experience to be the most effective system proposed to date.

4.5 Evaluation of Operational Adequacy

The operation of the dam has not been successful to the extent that the dam reportedly has overtopped two to three times yearly prior to 1978 resulting in the inundation of several summer dwellings

located downstream. Reportedly, since 1978, the beginning of the drought, the dam has not overtopped. Reportedly, when overtopping occurs it is actually the tailwater rising to an elevation higher than the top of dam, this being caused by the inadequacy of the downstream channel.

Although maintenance has been good in some areas, some aspects of dam maintenance have not been satisfactorily performed, including the following:

1) The steel sheet pilings along the right side of the river are significantly rusted with scales peeling off and have not been maintained.

2) The right river bank downstream from the dam is eroding and should be stabilized. The left bank appears to be undermined and should be stabilized.

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design Data

The quantity of storm water runoff that the spillway should be able to handle is based on the size and hazard classification of the dam. This runoff quantity, called the spillway design flood (SDF) is described in terms of return frequency or probable maximum flood (PMF) depending on the extent of the dam's size and potential hazard. According to the "Recommended Guidelines for Safety Inspection of Dams " published by the U.S. Army Corps of Engineers, the SDF for Smithville Dam falls in a range of 1/2 PMF to PMF. In this case, the lower end of the range, 1/2 PMF, is chosen since the factors used to select size and hazard classification are on the low side of their respective ranges.

The inflow hydrograph for the Smithville Dam impoundment was calculated using Clark's Method with a synthetic time-area curve. General hydrologic characteristics such as: Drainage Area (DA), Surface Storage Index (S_t), Main Channel Slope (S) and Man-made Impervious Cover Index (I) were computed using USGS quadrangles. These data were used in conjunction with the following equations to determine the Clark's Method Parameters (R and T_c):

$$T_c + R = 21.0\ (DA/S)^{0.22}\ \ (ST)^{0.33}\ (1.0 + 0.3(I))^{-0.28}$$

$$T_c = 6.82\ (DA/S)^{0.17}\ \ (ST)^{0.41}\ (1.0 + 0.3\ (I))^{-0.42}$$

The total drainage area contributing to Smithville Dam is 132 square miles. Most of the watershed is undeveloped woodland, swamp and cranberry bogs. There are four moderately sized population centers in the watershed: Fort Dix Military Reservation, Pemberton, Vincetown and Browns Mills. The SDF peak computed for the dam is 13,592 c.f.s.

Reservoir storage capacities were estimated using surface areas measured from USGS quadrangles. Discharge hydraulics for the spillway facilities were computed by considering the slide gates as sharp-crested weirs (See Appendix 4). The spillway discharge with lake level equal to the top of dam was computed to be 1,062 c.f.s. It should be noted that the spillway discharge capacity as indicated in the NJDEP files was 1012 c.f.s. The SDF was routed through the dam by use of the HEC-1-DAM computer program using the modified Puls Method. In routing the SDF, it was found that the dam crest would be overtopped by a depth of 4.2 feet. The analysis indicated that failure of the dam would not significantly increase the potential for loss of life over that which would exist without failure. Accordingly, the subject spillway is assessed as being inadequate in accordance with criteria developed by the U.S. Army Corps of Engineers.

b. Experience Data

Reportedly, the dam has not been overtopped since the drought began in 1978. However, prior to 1978, the dam was overtopped two or three times a year as noted previously in this report resulting in the inundation of several summer dwellings located downstream. .

Also, a note accompanying Dam Application No. 329, dated January 31, 1939 stated: "Since discharge capacity of proposed new gates equals that of existing gates at Mount Holly water works dam, downstream, and since both dams are flooded out by back water under maximum flood flows, approval is recommended. Discharge capacity of proposed gates is also same as that of old dam at Smithville which is replaced by the proposed dam."

c. Visual Observation

No evidence was found at the time of inspection that would indicate that the dam had been overtopped in recent years.

d. Overtopping Potential

As indicated in paragraph 5.1.a, a storm of magnitude equal to the SDF would cause overtopping of the dam by a depth of 4.2 feet over the crest of the dam. The spillway is capable of passing approximately 8 percent of the SDF with lake level equal to the top of dam.

SECTION 6: STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

The dam appeared, at the time of inspection to be outwardly structurally sound with no evidence of unusual movement or distress.

b. Generalized Soils Description

The soils at Smithville Dam site are characterized by the alluvial deposits surrounding the lake. In the northern area, the alluvium is intermingled with soils of marine origin. In the southern area, alluvium composed mainly of silt and sand are found adjacent to the present stream courses.

The formation underlying the dam structure is the Mount Laurel and Wenonah Sands, as identified on the Geologic Map of New Jersey.

c. Design and Construction Data

The analysis of structural stability and construction data for the dam are not available. It should be noted, however, that correspondence and inspection reports which address the structural integrity of the dam were found in the NJDEP file and are as follows:

In a letter dated December 1, 1936, (Dam Permit File #222) the New Jersey State Water Policy Commission stated the following:

"We have examined this log (of a test hole) and are of the opinion that it would be unsafe to attempt to place the footing of a dam on top of the clay stratum encountered at a depth of

15 feet below the ground surface. This clay stratum is but 4 feet thick and is underlain by 35 feet of water-bearing quicksand.

We recommend the use of interlocking steel sheet piling about 60 feet long and continuous beneath all new structures to form a cut-off in the water-bearing quicksand by penetrating into the thick clay bed which underlies the quicksand."

A repair, following the June 6, 1936 blowout of the dam, included the driving of sheet piling to depths of 4 to 5 feet but this was temporary in nature and failed.

It should be noted that in an interoffice memo dated October 16, 1968 (Dam Permit File #472 - concerning the 1969 repairs) the following was stated:

"By studying the history of subject dam, I have discerned that the dam needed repairs twice within a span of twenty years.

Each time the repairs were made, they were identical to those proposed now.

Repairs were made in 1941, and repairs were made in 1954, and required repairs again at the estimated cost of $48,000.00 in 1965.

Under the circumstances, there would be no justification to grant approval for repairs without making a pointed reference to all concerned."

Information taken from the NJDEP Dam Permit File #329, gives a sample of test boring as submitted by Township Engineer, Edward K. Bryant, in 1939, and is as follows:

Sample of Test Borings at Site of New Smithville Dam

Depth(ft.)	Description	
0-5	Dark brown clayey sand with plant roots	Post Cape May
5-6	Slightly clayey, glauconitic, fine grained sand	Post Cape May
8-11	Typical coarse grained brown sand, and small pebbles of Cape May Formation	
11-18	Dark gray, glauconitic, micaceous, and clayey fine grained sand a relatively impermeable stratum	
18-31	Slightly clayey, fine-trained glauconitic and micaceous sand	
31-40	Fine-grained, gray highly glauconitic sand	
40-65	Gray micaceous, glauconitic and clayey sand. Mt. Laurel Wenonah formation	

Another test boring shown on the plan entitled "Proposed Repairs at Smithville Dam" dated July 10, 1967 prepared by M. Paul Austin Engr. Assoc. Inc. shows water-bearing black sandy clay beginning at a depth of 18 feet.

d. Operating Records

No operating records are available for the dam. The water level of the North Branch of the Rancocas Creek is visually monitored by the Burlington County Civil Defense.

e. Post-Construction Changes

It appears that the substructure of the dam as it exists today was constructed in accordance with plans prepared by the

Bureau of Navigation entitled "Plan of Proposed Repairs to Existing Smithville Dam," dated September 1953 and completed in 1954.

Modifications since that repair include the installation of hand gates in 1955, the repair of leakage through the old creosoted sheet piling at the right end of the spillway around 1957, and the replacement of the bulkhead and timber gates in accordance with plans prepared by Richard A. Alaimo Associates, entitled "Proposed Bulkhead Replacement, dated October 1968."

The most recent modification to the dam occurred in 1980 when the twelve timber slide gates were removed and replaced with wheel-operated metal slide gates by the County of Burlington. Throughout all repairs, reconstructions, and modifications to the dam the original design concept of twelve slide gates as proposed in 1934 has remained intact.

f. Seismic Stability

Smithville Dam is located in Seismic Zone 1 as defined in "Recommended Guidelines for Safety Inspection of Dams" which is a zone of very low seismic activity. Experience indicates that dams in Seismic Zone 1 will have adequate stability under seismic loading conditions if they have adequate stability under static loading conditions. Smithville Dam appeared to be stable under static loading conditions at the time of inspection.

SECTION 7: ASSESSMENT AND RECOMMENDATIONS

7.1 Dam Assessment

a. Safety

Based on hydraulic and hydrologic analyses outlined in Section 5 and Appendix 4, the spillway of Smithville Dam is assessed as being inadequate. The spillway is not able to pass the SDF without an overtopping of the dam.

The dam appeared, at the time of inspection, to be outwardly structurally stable.

b. Adequacy of Information

Information sources for this report include 1) field inspection, 2) USGS quadrangle, 3) various plans for repairs of Smithville Dam prepared by various engineers and agencies, 4) correspondence, inspection reports and other information contained in the files of the NJDEP, and 5) consultation with Highway Dept, Engineering Dept. and Civil Defense personnel of the County of Burlington. The information obtained is sufficient to allow a Phase I assessment as outlined in "Recommended Gudielines for Safety Inspection of Dams."

Some of the absent data are as follows:

1) Design computations and reports.
2) Maintenance documentation.

c. Necessity for Additional Data/Evaluation

Although some data pertaining to Smithville Dam are not available, additional data are not considered imperative for this Phase I evaluation.

7.2 Recommendations

a. Remedial Measures

Based on hydraulic and hydrologic analyses outlined in paragraph 5.1.a, the spillway is considered to be inadequate. However, more detailed hydraulic and hydrologic studies are recommended only in connection with studies of other dams in the same drainage system and with structural stability investigations outlined below.

In light of past failures of the dam and the recommendation in 1936 to drive significantly longer steel sheet piling, the structural stability of the dam should be investigated in the future by a professional engineer experienced in the design and construction of dams. The investigation should include consideration of the effects of overtopping during the SDF on the stability of the dam and adjacent stream banks. As a result of the investigation, the need for and type of remedial measures should be determined and then impelemented.

The owner should continue to employ the surveillance and emergency action plan currently in use. In the future, the plan should be reviewed and, after any necessary revisions, incorporated into a formal written plan.

In addition, it is recommended that the following remedial measures be undertaken in the near future:

1) The steel sheet piling abutments at each end of the dam should be renovated by cleaning, painting and replacement of the wales.

2) The stabilization of the stream banks downstream from the dam should be renovated.

b. Maintenance

In the future, the owner of the dam should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam.

PLATES

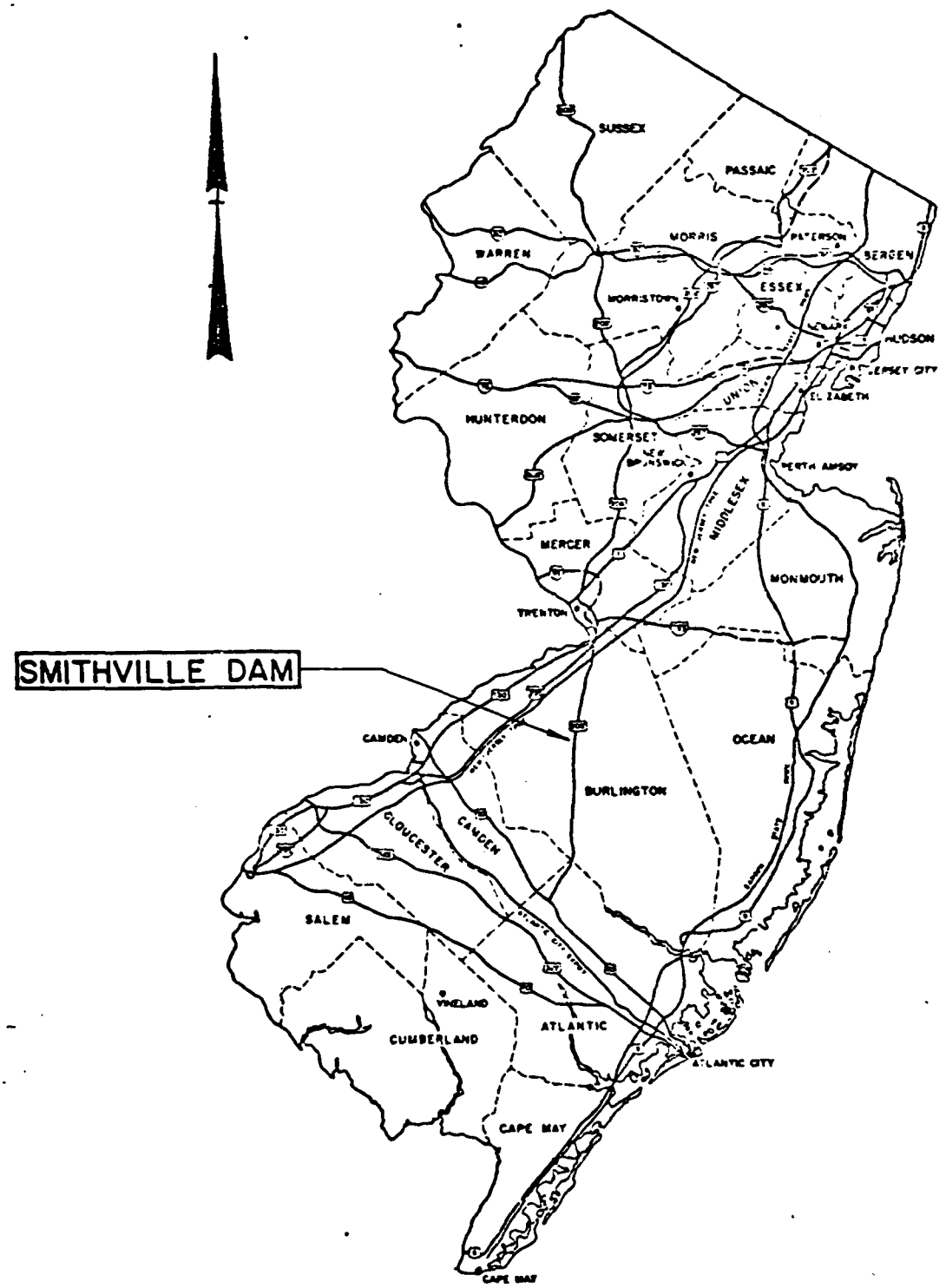


PLATE 1

STORCH ENGINEERS
FLORHAM PARK, NEW JERSEY

DIVISION OF WATER RESOURCES
N.J. DEPT. OF ENVIR. PROTECTION
TRENTON, NEW JERSEY

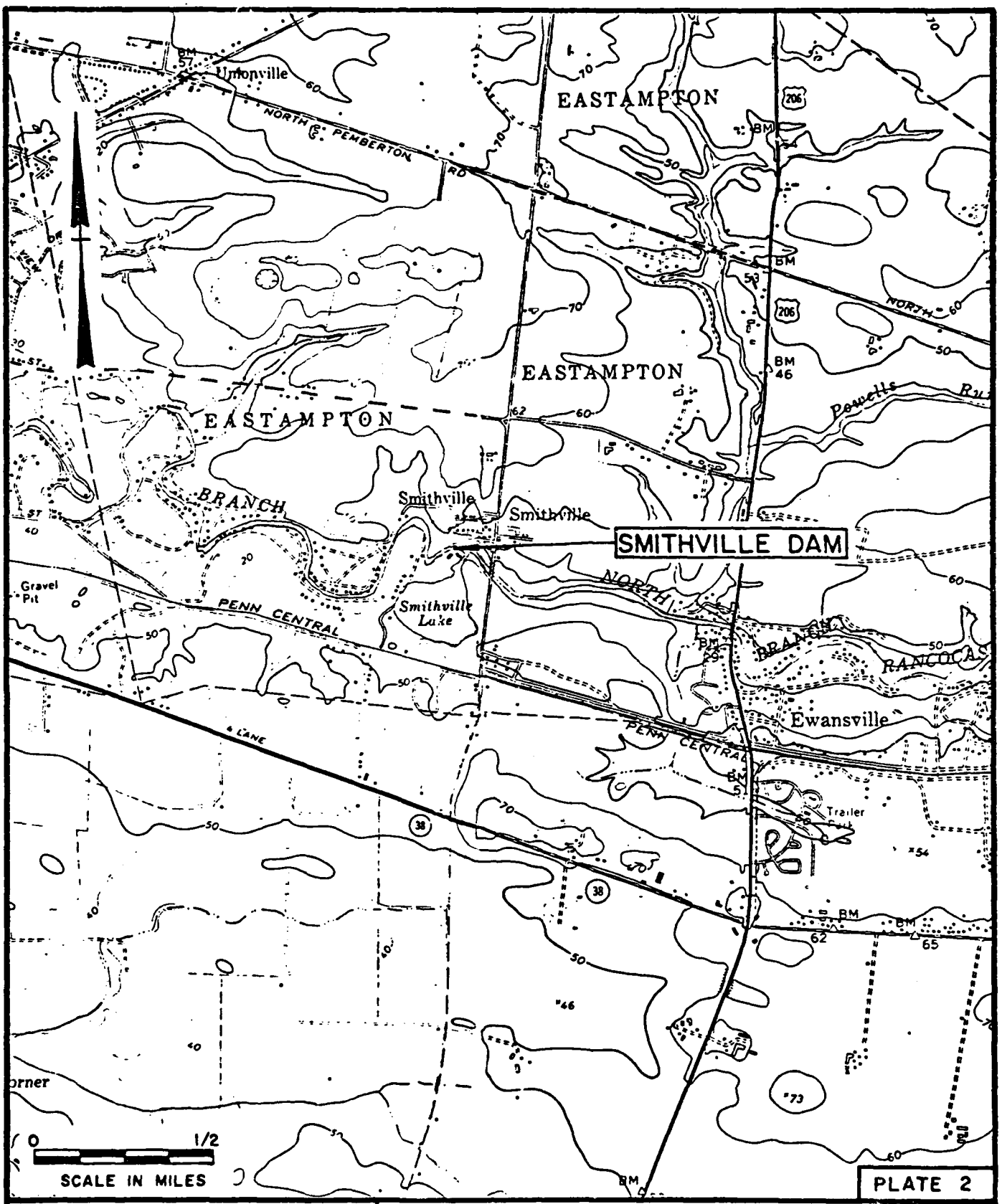
INSPECTION AND EVALUATION OF DAMS

KEY MAP

SMITHVILLE DAM

SCALE: NONE

DATE: FEB. 1981



STORCH ENGINEERS
FLORHAM PARK, NEW JERSEY

DIVISION OF WATER RESOURCES
N.J. DEPT. OF ENVIR. PROTECTION
TRENTON, NEW JERSEY

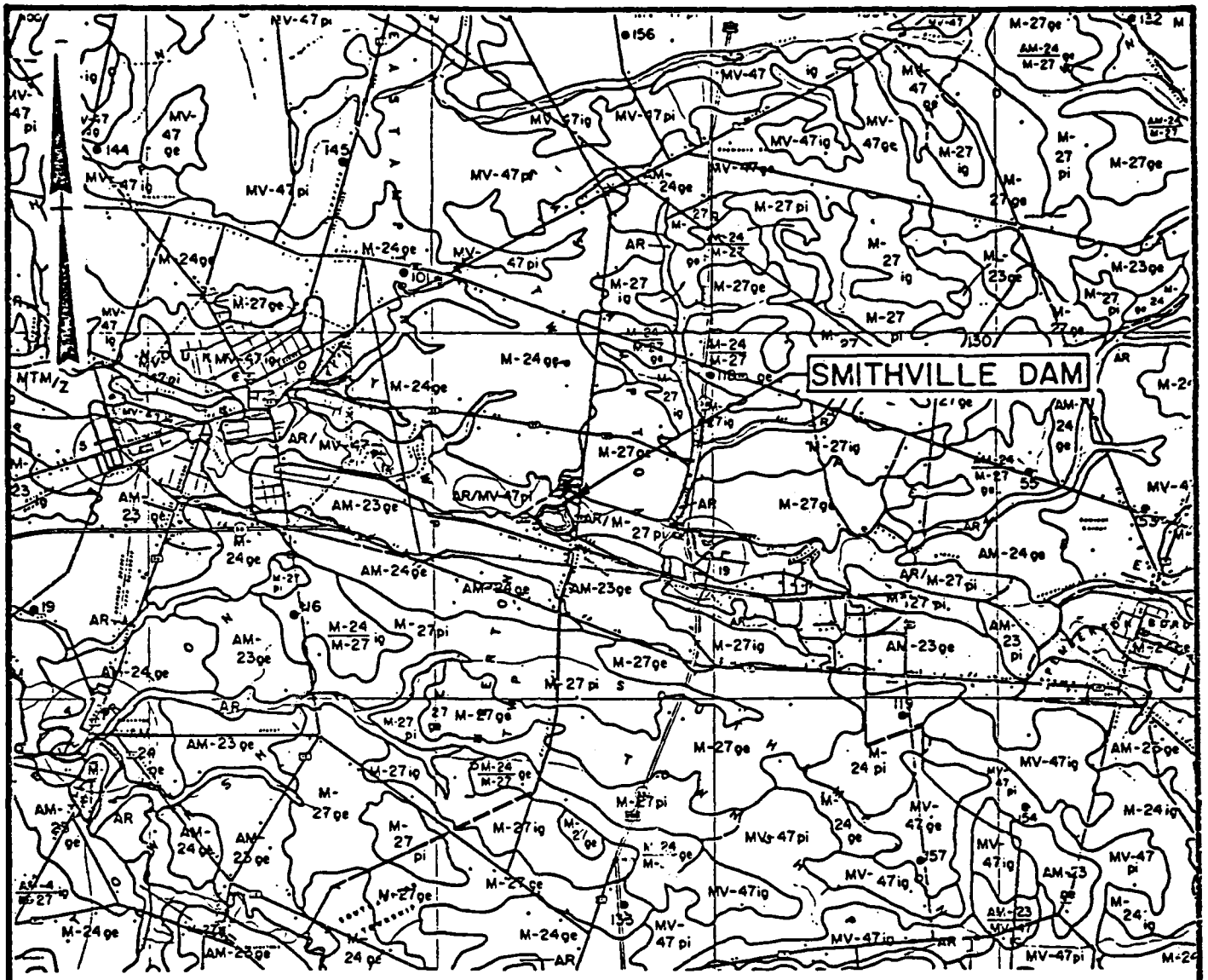
INSPECTION AND EVALUATION OF DAMS

VICINITY MAP

SMITHVILLE DAM

SCALE: AS SHOWN

DATE: FEB. 1981



Legend

M-27	Stratified deposits of marine origin.
AM-24	Unconsolidated, stratified alluvial deposits.
AM-23	Irregualr mantle of stratified alluvial material.
AR	Recent alluvium deposited adjacent to present stream courses.

Note: Information taken from Rutgers University, Soil Survey of New Jersey, Report No. 20, Burlington County, May 1955 and Geologic Map of New Jersey prepared by J.V. Lewis and H. Kummel 1910-1912, revised by H. B. Kummel 1931 and M. Jhnson 1950.

PLATE 3

STORCH ENGINEERS
FLORHAM PARK, NEW JERSEY.

DIVISION OF WATER RESOURCES
N.J. DEPT. OF ENVIR. PROTECTION
TRENTON, NEW JERSEY.

INSPECTION AND EVALUATION OF DAMS

SOIL MAP

SMITHVILLE DAM

SCALE: NONE

DATE: FEB. 1981

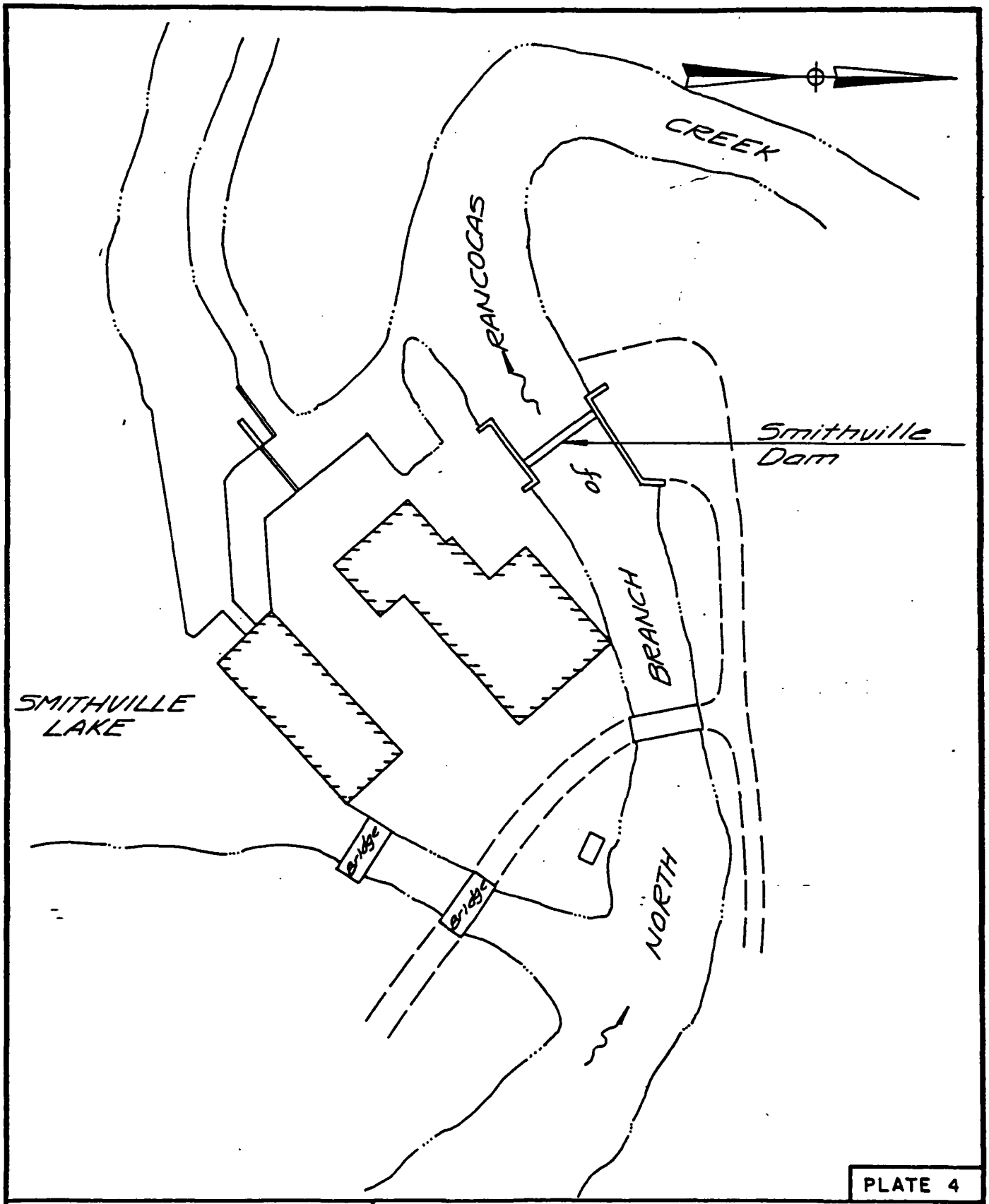


PLATE 4

STORCH ENGINEERS
FLORHAM PARK, NEW JERSEY

DIVISION OF WATER RESOURCES
N.J. DEPT. OF ENVIR. PROTECTION
TRENTON, NEW JERSEY

INSPECTION AND EVALUATION OF DAMS

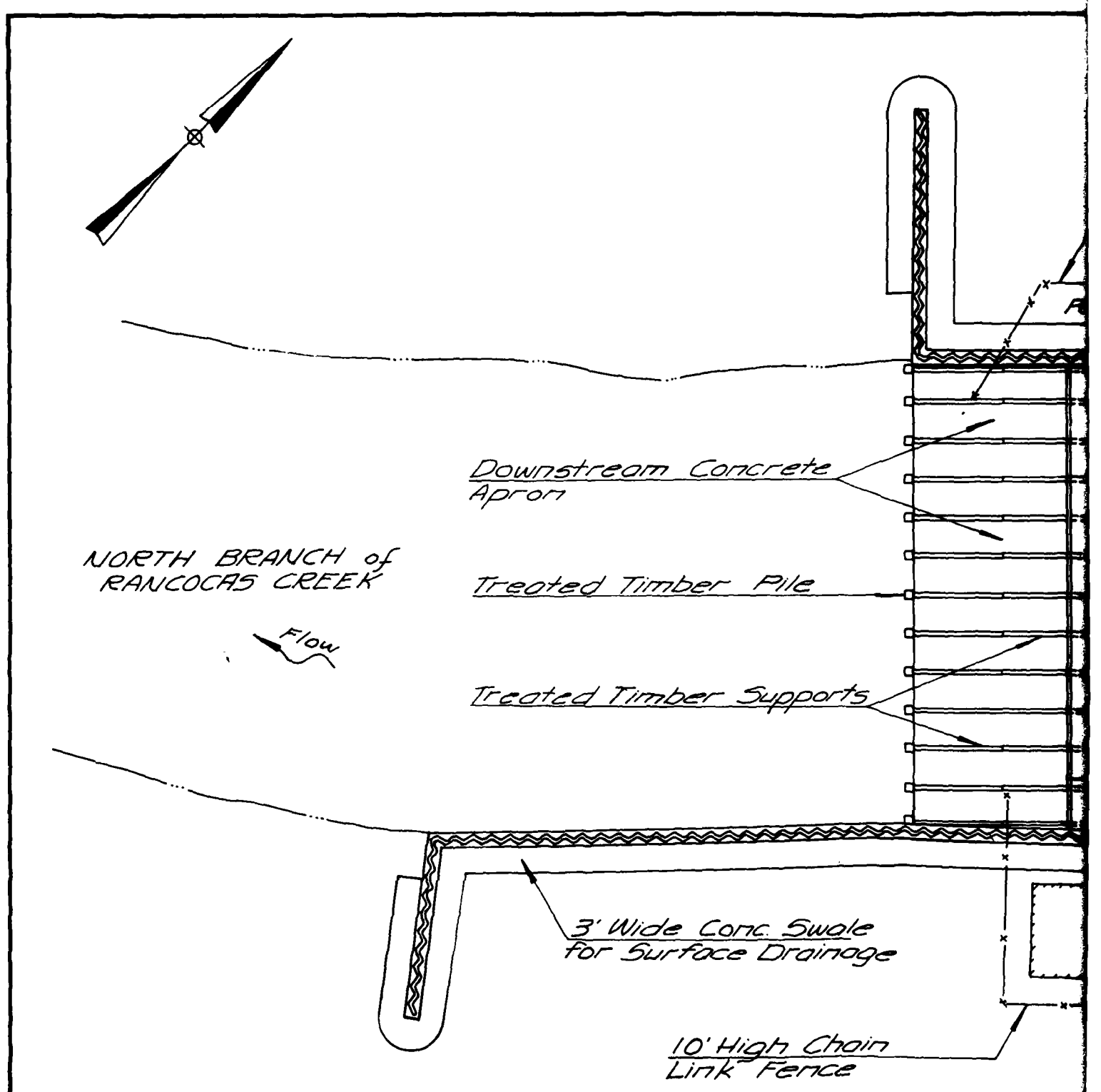
OVERVIEW

SMITHVILLE DAM

I.D. N.J. 00043

SCALE: NONE

DATE: APRIL, 1981



Note:
Information taken from:

1. "Plan of Proposed Repairs to Existing Smithville Dam" dated 9/53 prepared by Bureau of Navigation.
2. "Proposed Bulkhead Replacement - Smithville Dam" dated 12/6/68 prepared by Richard A. Alaimo Assoc.
3. "Replacement of Floodgates - Smithville Dam" dated 2/11/80 prepared by Burlington County Engineering Dept.
4. Field Inspection Janurary 6, 1981.

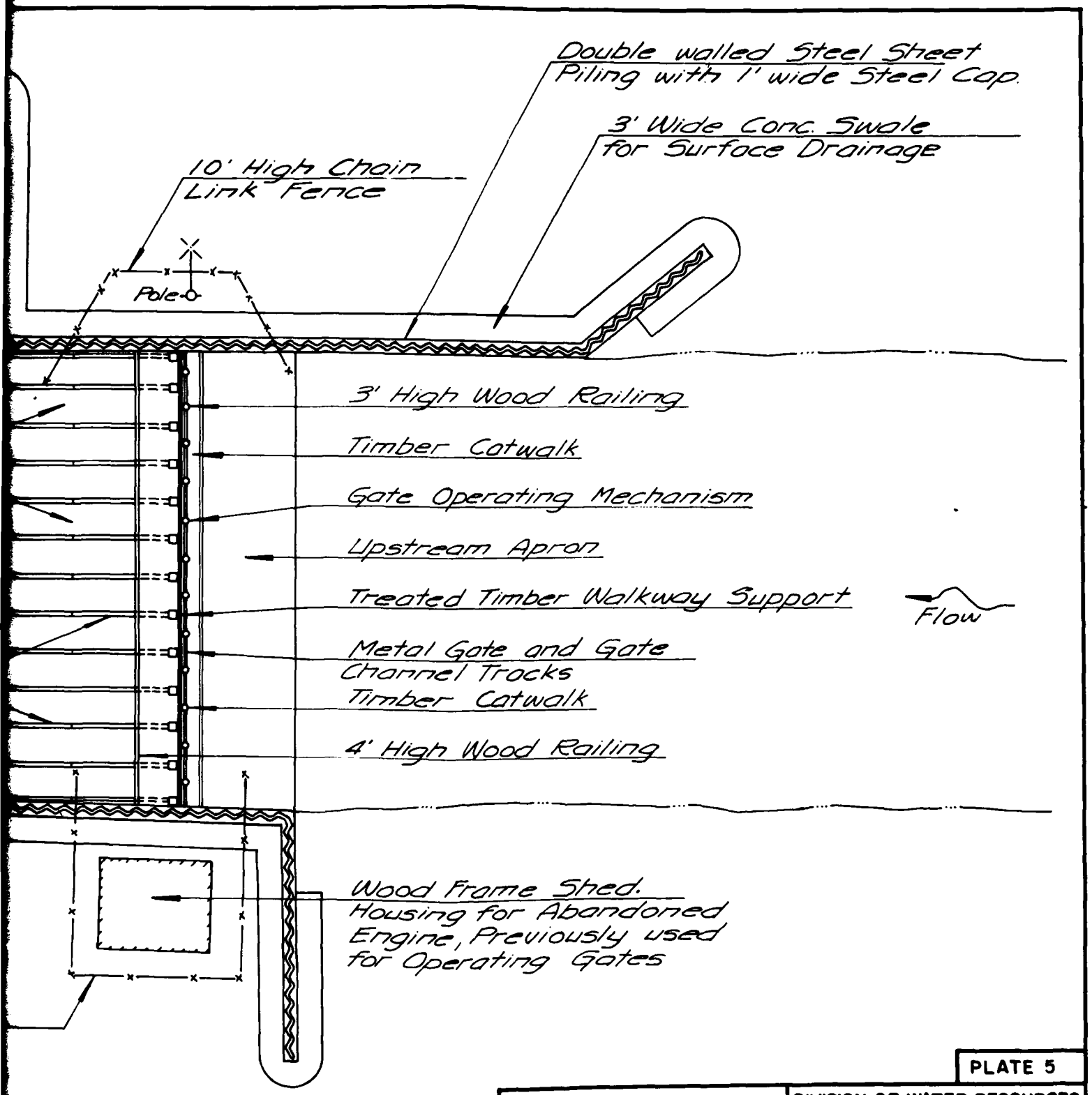


PLATE 5

STORCH ENGINEERS FLORHAM PARK, NEW JERSEY	DIVISION OF WATER RESOURCES N.J. DEPT. OF ENVIR. PROTECTION TRENTON, NEW JERSEY

INSPECTION AND EVALUATION OF DAMS

GENERAL PLAN

SMITHVILLE DAM

I.D. N.J. 00043	SCALE: NOT TO SCALE
	DATE: FEB, 1981

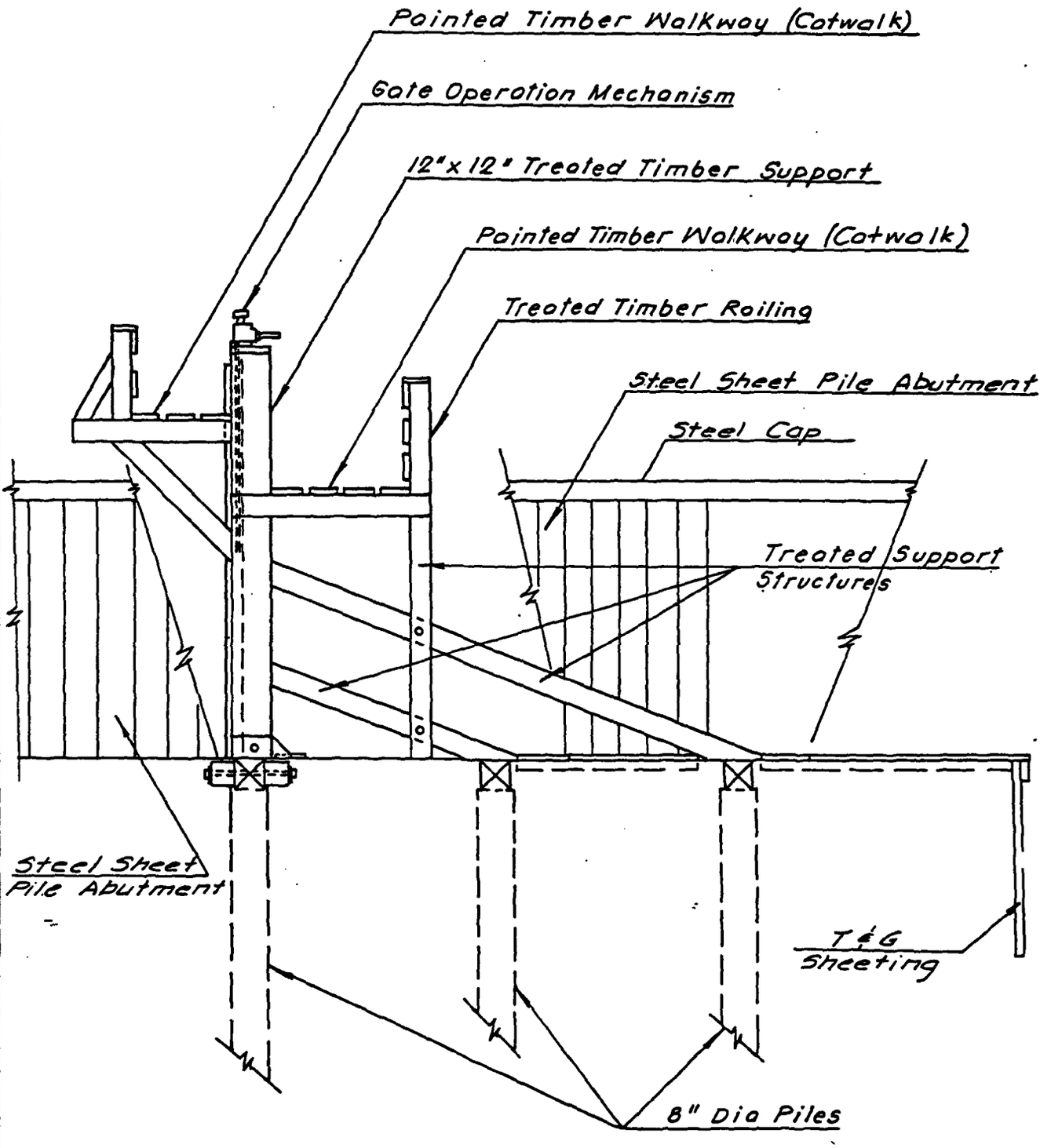


PLATE 6

STORCH ENGINEERS
FLORHAM PARK, NEW JERSEY

DIVISION OF WATER RESOURCES
N.J. DEPT. OF ENVIR. PROTECTION
TRENTON, NEW JERSEY

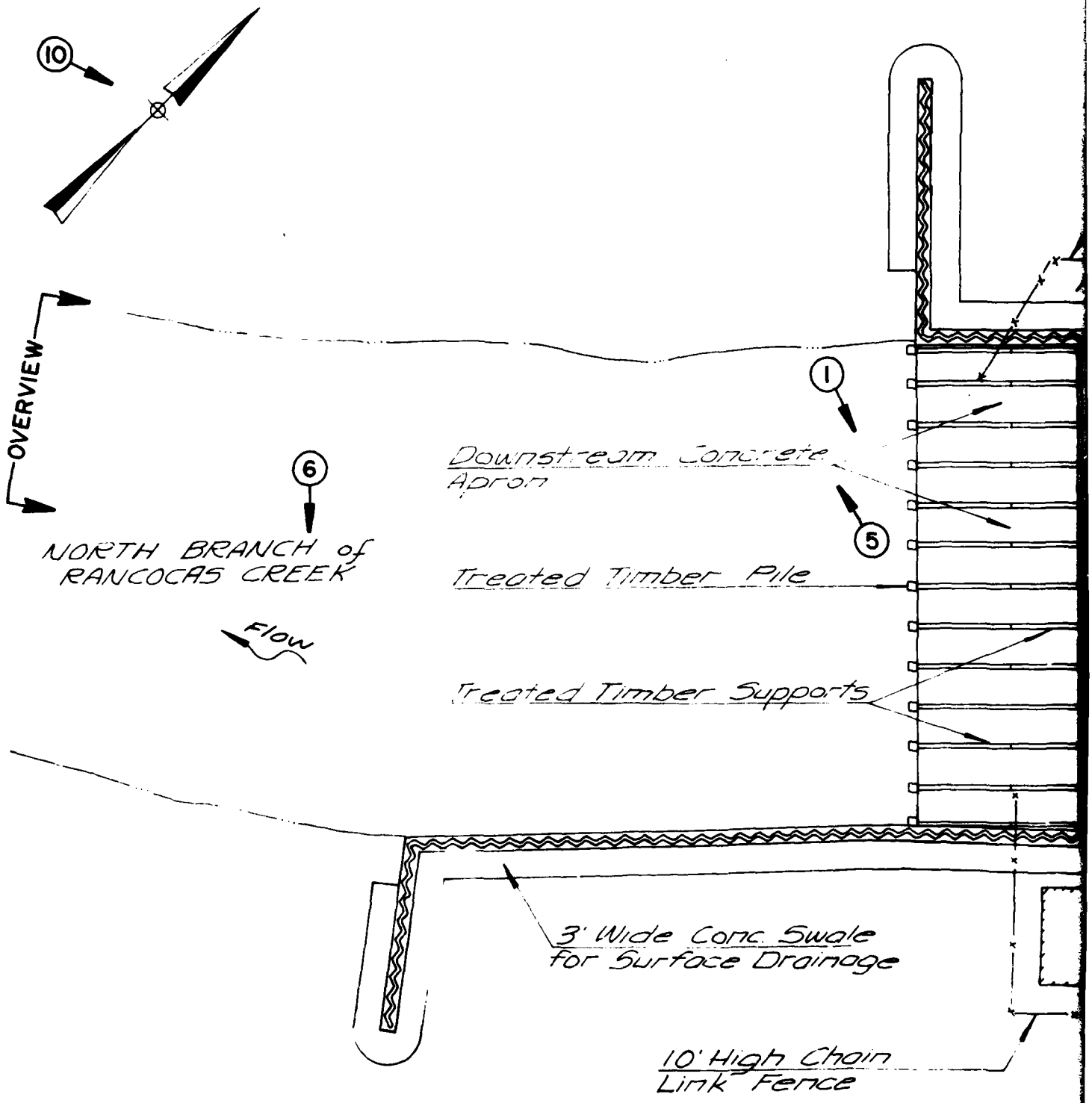
INSPECTION AND EVALUATION OF DAMS

SPILLWAY SECTION
SMITHVILLE DAM

I.D. NJ 00043

SCALE: NONE

DATE: FEB. 1981



Note
Information taken from:

1 "Plan of Proposed Repairs to Existing Smithville Dam" dated 9/53 prepared by Bureau of Navigation
2 "Proposed Bulkhead Replacement - Smithville Dam" dates 12/6/68 prepared by Richard A Alaimo Assoc
3 "Replacement of Floodgates - Smithville Dam" dated 2/11/80 prepared by Burlington County Engineering Dept
4 Field Inspection January 6, 1981

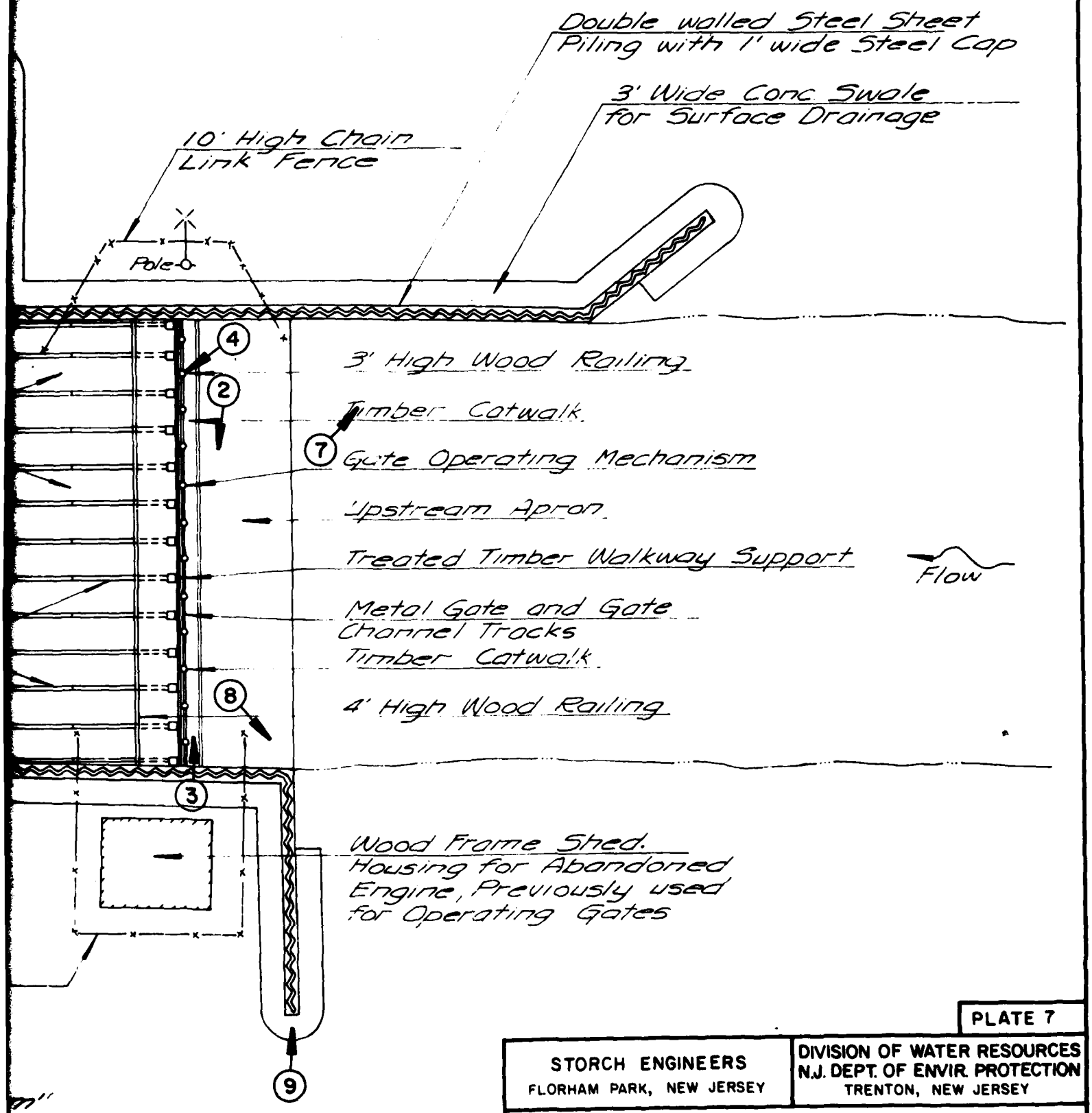


PLATE 7

STORCH ENGINEERS FLORHAM PARK, NEW JERSEY	DIVISION OF WATER RESOURCES N.J. DEPT. OF ENVIR. PROTECTION TRENTON, NEW JERSEY

INSPECTION AND EVALUATION OF DAMS

PHOTO LOCATION PLAN

SMITHVILLE DAM

I.D. N.J. 00043	SCALE: NOT TO SCALE
	DATE: FEB, 1981

APPENDIX 1

Check List - Visual Inspection

Check List - Engineering Data

Check List

Visual Inspection

Phase I

Name of Dam Smithville Dam County Burlington State N.J. Coordinators NJDEP

Date(s) Inspection 1/6/81 Weather P. Cloudy Temperature 25° F.

Pool Elevation at time of Inspection 18.5 M.S.L. Tailwater at Time of Inspection 13.3 M.S.L.

Inspection Personnel:

John Gribbin Richard McDermott

Daniel Buckelew

Mark Brady

John Gribbin Recorder

Present: Mr. Reese Thomas, Assistant Road Supervisor, Burlington County.

OUTLET WORKS

ISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ONCRETE SURFACES IN UTLET CONDUIT	N.A.	Outlet works consist of slide gates in spillway structure.
NTAKE STRUCTURE	N.A.	
UTLET STRUCTURE	N.A.	
UTLET CHANNEL	Gates discharge directly into downstream channel.	
TE AND GATE HOUSING	Twelve metal gates, tracks and operating mechanisms appeared to be recent and in satisfactory condition.	

. SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
EIR	Weir formed by tops of slide gates appeared to be in satisfactory condition.	
UTMENTS	Steel sheet piles appeared generally sound but rusted with rust scales peeling off. Steel cap was in satisfactory condition. Concrete surface runoff swales adjacent to abutments were in satsifactory condition. Steel wales significantly rusted.	Abutments formed by interlocking steel sheet piles driven along stream banks perpendicular to dam and keyed into banks. Steel sheet piles should be cleaned and treated for rust.
RON	Concrete and timber downstream apron appeared to be in satisfactory condition.	Apron obscured by discharge at the time of inspection.
BER BRACES	Timber bracing appeared to be treated and in satisfactory condition.	
WALKS	Timber catwalks (upstream and downstream sides of gates) were in satisfactory condition.	Some planks appeared to have been replaced.

INSTRUMENTATION

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None	
OBSERVATION WELLS	None	
WEIRS	None	
PIEZOMETERS	None	
OTHER		

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Upstream stream banks approx. 3' high at time of inspection.	
SEDIMENTATION	Unknown	
STRUCTURES ALONG BANKS	Old brick building located on left bank immediately upstream from dam. First floor about 3' above water level. Road bridge located about 250' upstream. Dwellings loacted around a portion of Smithville Lake.	Smithville Lake located adjacent to stream on which dam is located. Intake from stream to lake located about 300' upstream from dam.

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTION, DEBRIS, ETC.)	Meandering stream (North Branch Rancocas Creek) with sharp bend to right about 200' downstream from dam.	
SLOPES	In vicinity of dam, slopes stabilized by concrete. Conc. stabilization on left bank appeared undermined. Stabilization on right bank consisted of large pieces of concrete. Stabilization appeared to be unsatisfactory.	Bank stabilization should be renovated.
STRUCTURES ALONG BANKS	Several dwellings located along stream within one mile. Mill Dam and urban development of Mt. Holly located about 2 miles downstream.	

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM		REMARKS
DAM -	PLAN	"Proposed Bulkhead Replacement - Smithville Dam", dated 12/6/68 by Richard A. Alaimo Assoc. available in NJDEP Dam Permit Files, NJDEP, Division of Water Resources, P.O. Box CN-029, Trenton, NJ, 08625.
	SECTIONS	Alaimo Plans - 12/6/68
SPILLWAY -	PLAN	"Plan of Proposed Repairs to Existing Smithville Dam", dated 9/53, by Bureau of Navigation available in NJDEP Dam Permit Files.
	SECTIONS	Bureau of Navigation Plans - 9/53
	DETAILS	Bureau of Navigation Plans - 9/53
OPERATING EQUIPMENT PLANS & DETAILS		"Replacement of Floodgates - Smithville Dam" dated 2/11/80 by Burlington County. Available at Burlington County Engineering Dept., 49 Rancocas Rd., Mt. Holly, N.J.
OUTLETS -	PLAN	Burlington County Plans - 2/11/80
	DETAILS	Burlington County Plans - 2/11/80
	CONSTRAINTS	Burlington County Plans - 2/11/80
	DISCHARGE RATINGS	1012 c.f.s. based upon 1941 design. Same as 1934 design. Available in NJDEP Dam Permit Files.
HYDRAULIC/HYDROLOGIC DATA		Available in NJDEP Files.
RAINFALL/RESERVOIR RECORDS		Not Available
CONSTRUCTION HISTORY		Available in NJDEP Files
LOCATION MAP		"Plan of Lots Vicinity Smithville Dam" dated 2/20/67 by M. Paul Austin Engr. Assoc. Inc. Available in NJDEP Files

ITEM	REMARKS
DESIGN REPORTS	Not Available
GEOLOGY REPORTS	Test Holes, Boring Logs and comments available in NJDEP Files.
DESIGN COMPUTATIONS	
HYDROLOGY & HYDRAULICS	Available in NJDEP Files
DAM INSTABILITY	Not Available
SEEPAGE STUDIES	Not Available
MATERIALS INVESTIGATIONS	
BORING RECORDS	Available in NJDEP Files
LABORATORY	Not Available
FIELD	Available in NJDEP Files
POST-CONSTRUCTION SURVEYS OF DAM	Inspection reports available in NJDEP Files
BORROW SOURCES	Available in NJDEP Files

ITEM	REMARKS
MONITORING SYSTEMS	Informal but reportedly effective visual inspection and warning system currently in use. Administered by Burlington County Civil Defense.
MODIFICATIONS	Repairs and reconstructions of 1934, 1937, 1941, 1953, and 1969 available in NJDEP Files 1980 floodgate replacement at Burlington County Engineering Dept.
HIGH POOL RECORDS	September 1938 - Available in NJDEP Files
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	Not Available
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	Available in NJDEP Files
MAINTENANCE OPERATION RECORDS	Not Available

APPENDIX 2

Photographs

PHOTO 1
DOWNSTREAM SIDE OF GATES

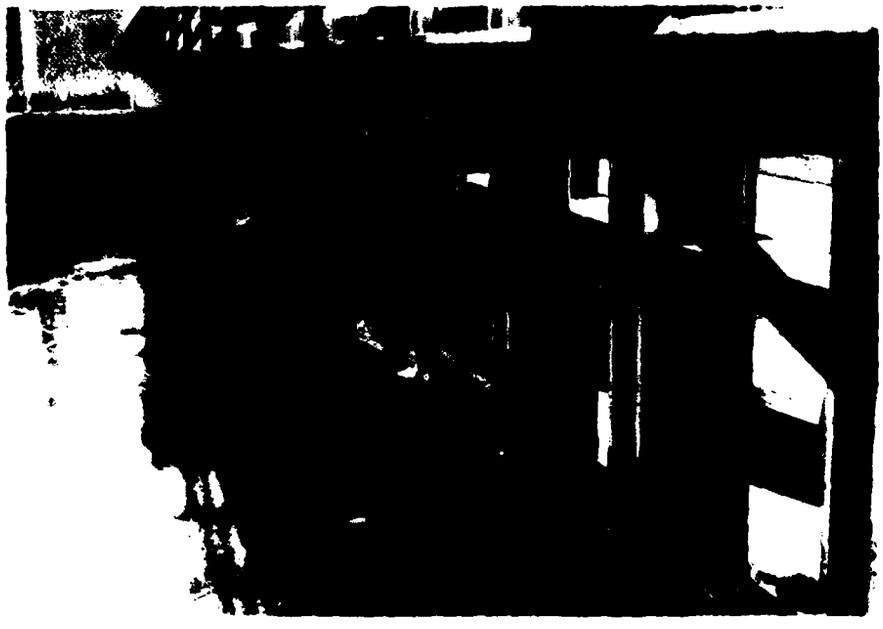


PHOTO 2
UPSTREAM SIDE OF GATES

SMITHVILLE DAM
6 JANUARY 1981

PHOTO 3
TIMBER CATWALKS AND GATE OPERATING MECHANISMS

PHOTO 4
TYPICAL GATE, STEM AND TRACKS

SMITHVILLE DAM
6 JANUARY 1981

PHOTO 5
RIGHT BANK OF CHANNEL - DOWNSTREAM

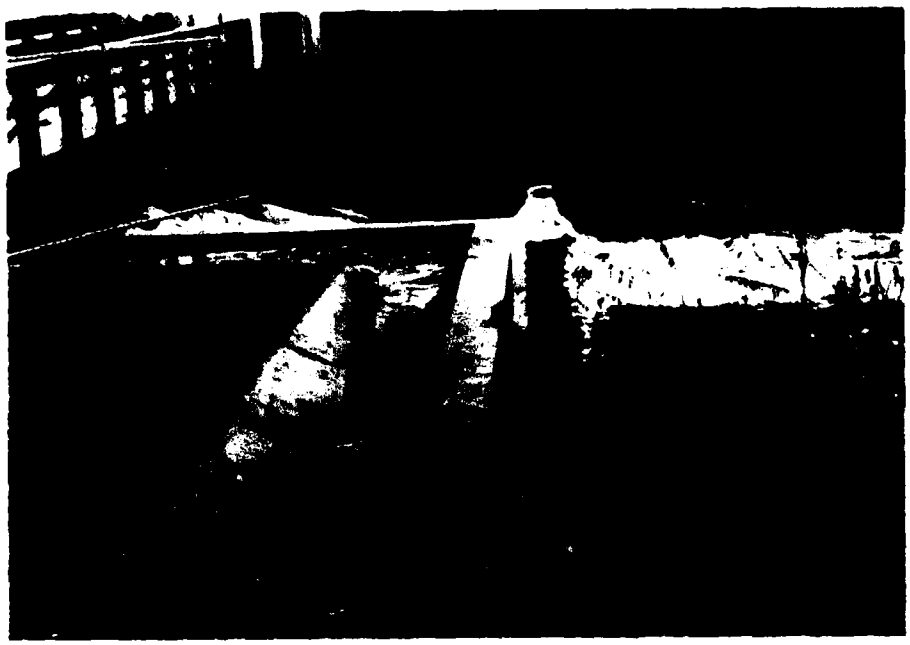
PHOTO 6
LEFT BANK OF CHANNEL - DOWNSTREAM

SMITHVILLE DAM
6 JANUARY 1981

PHOTO 7
RIGHT STEEL SHEET PILE ABUTMENT

PHOTO 8
LEFT STEEL SHEET PILE ABUTMENT

SMITHVILLE DAM
6 JANUARY 1981



6 JANUARY 1981

PHOTO 9

SURFACE RUNOFF SWALE

31 JANUARY 1981

PHOTO 10

AERIAL VIEW OF DAM SHOWING SMITHVILLE LAKE WITH INTAKE ABOVE DAM AND DISCHARGE BELOW DAM

SMITHVILLE DAM

APPENDIX 3

Engineering Data

CHECK LIST

HYDROLOGIC AND HYDRAULIC DATA

ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: Woodland, swamps and cranberry bogs.

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 18.6 (65 acre-feet)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): N.A.

ELEVATION MAXIMUM DESIGN POOL: 26.2

ELEVATION TOP DAM: 22.0

SPILLWAY CREST:

a. Elevation 18.6

b. Type Sharp-crested weir

c. Width N.A.

d. Length 51 feet

e. Location Spillover Tops of gates

f. Number and Type of Gates 12 metal slide gates

OUTLET WORKS:

a. Type Slide gates

b. Location Along full length of dam

c. Entrance Invert N.A.

d. Exit Invert 13.6

e. Emergency Draindown Facilities: Open gates

HYDOMETEOROLOGICAL GAGES: None

a. Type N.A.

b. Location N.A.

c. Records N.A.

MAXIMUM NON-DAMAGING DISCHARGE:

(Lake Stage Equal to Top of Dam) 1062 c.f.s.

APPENDIX 4

Hydraulic/Hydrologic Computations

HYDROLOGY

Unit hydrograph for Smithville Dam will be developed using Clark's parameters calculated from the following equations:

$$T_c + R = 21.0\left(DA/S\right)^{0.22}\left(ST\right)^{0.33}\left(1.0+0.3\left(I\right)\right)^{-0.28}$$

$$T_c = 6.82\left(DA/S\right)^{0.17}\left(ST\right)^{0.41}\left(1.0+0.3\left(I\right)\right)^{-0.42}$$

Supplied by the U.S. Army Corps of Engineers

Where: I = % Impervious Cover

DA = Drainage Area (Sq. Mi.)

ST = % Storage Area (Lakes & Swamps)

S = Average Channel Slope Between the Points 10 and 85 percent of the Distance Upstream From the Outflow Point (Dam) to the Watershed Boundary. (ft./mi.)

SQUARE 4 X 4 TO THE INCH

HYDROLOGY (cont.)

1. Drainage Area = 132 SQ. MI.

2. Average Channel Slope:

Total Length = 27.2 MI.

Elevation at a distance of 2.72 Miles from the dam = 20 ft.

Elevation at a distance of 23.12 Miles from the dam = 120 ft.

Average Channel Slope = $\frac{120-20}{23.12-2.72}$

= 4.90 ft./mi.

3. Storage Area = 11.5 SQ. MI.

$ST = \frac{11.5}{132} \times 100 = 8.7\ \%$

4. Population:

Total = 56,800

Population Density = $\frac{56,800}{132}$ = 430 PERSONS/SQ. MI.

HYDROLOGY (con't.)

4. IMPERVIOUS COVER INDEX

$$I = 0.117 [D]^{0.792 - 0.039 \log_{10} D}$$

from Special Report 38 by U.S.G.S. with NJDEP 1974.

$$= 0.117 [430]^{0.792 - 0.039 \log_{10} D}$$

$$= 0.117 [430]^{0.792 - 0.10}$$

$$= 0.117 [430]^{0.688}$$

$$= 7.59 \%$$

5. Unit Hydrograph Parameters

$$TC+R = 21.0 (DA/S)^{0.22} (ST)^{0.33} (1.0 + 0.3 I)^{-0.28}$$

$$= 21.0 (132/4.90)^{0.22} (8.7)^{0.33} (1.0 + 0.3 \times 7.59)^{-0.28}$$

$$= 21.0 (26.9)^{0.22} (8.7)^{0.33} (3.277)^{-0.28}$$

$$TC+R = 63.5$$

$$TC = 6.82 (DA/S)^{0.17} (ST)^{0.41} (1.0 + 0.3 (I))^{-0.42}$$

$$= 6.82 (132/4.90)^{0.17} (8.7)^{0.41} (1.0 + 0.3 (7.59))^{-0.42}$$

$$= 6.82 (1.75) (2.43) (0.61)$$

$$= 17.69$$

HYDROLOGY (con't.)

TC = 17.7

TC+R = 63.5

17.7 + R = 63.5

R = 45.8 Hrs.

COMPUTER INPUT

FOR HEC-1-DAM INPUT USE

TC = 17.6 Hrs.

R = 46.0 Hrs.

PRECIPITATION (U.S.D.C. Rep. 40 pg 57)

Probable maximum precipitation = 27 inches for 6 hours duration and 10 sq. mi. area.

Percentange of PMP for 132 SQ. Mi.

Duration (hr.)	% PMP
6	77
12	84
24	93

STORCH ENGINEERS

Project SMITHVILLE DAM

Sheet 5 of 9

Made By JLP Date 4-1-81

Chkd By JG Date 4/10/81

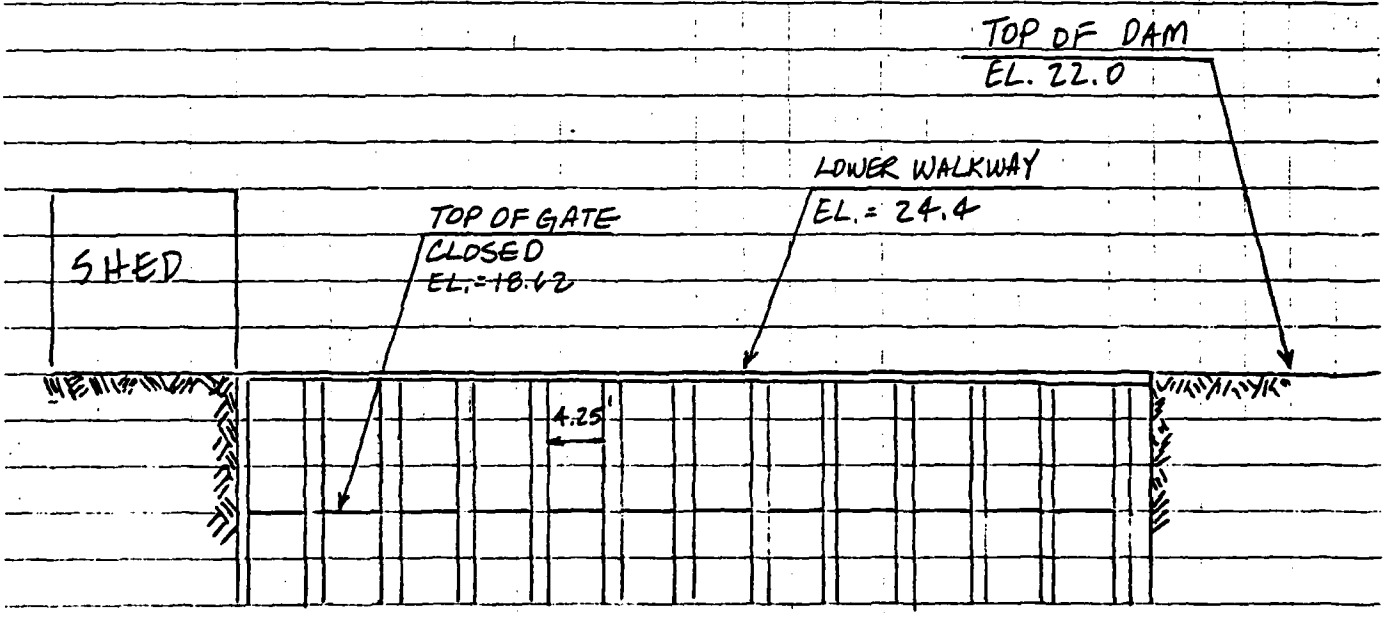
LAKE STORAGE VOLUME

ELEVATION (ft.)	AREA (acres)
13.3	0
18.6	36.7
30	192.8
40	495.8

HEC-1-DAM COMPUTER PROGRAM WILL DEVELOP STORAGE CAPACITY FROM WATER SURFACE AREA AND ELEVATIONS. INFORMATION TAKEN FROM U.S.G.S. QUADRANGLE MOUNT HOLLY, N.J.

HYDRAULICS

THE SPILLWAY AT SMITHVILLE LAKE DAM CONSISTS OF 12 SLIDE GATES FITTED IN A TIMBER FRAME CONSTRUCTED ACROSS THE RIVER. DISCHARGE WILL BE COMPUTED AS A SHARP CRESTED WEIR: DISCHARGE, Q CAN BE CALCULATED AS $Q = CLH^{3/2}$



where: C = discharge coefficient over spillway
L = effective length of spillway (ft.)
H = total head on spillway (ft.)
Q = discharge over spillway (cfs)

STORCH ENGINEERS

Project SMITHVILLE DAM

Sheet 7 of 9

Made By JLP Date 4-1-81

Chkd By JG Date 4/10/81

SPILLWAY STAGE DISCHARGE TABULATION

EL. (ft.)	TAILWATER EST (ft)	C	L (ft.)	H (ft.)	Q (cfs)	x12 Q (cfs)
18.6	—	3.32	4.25	0.0	0	0
18.8	—	3.32	4.25	0.2	1.26	15
19.0	—	3.32	4.25	0.4	3.57	43
19.5	14	3.32	4.25	0.9	12.05	145
20.0	15	3.32	4.25	1.4	23.37	280
21.0	17	3.32	4.25	2.4	52.46	630
22.0	18	3.32	4.25	3.4	88.45	1062
24.0	21*	2.89	4.25	5.4	154.1	1850
26.0	24*	2.29	4.25	7.4	195.9	2351
30.0	28*	1.93	4.25	11.4	315.7	3789
34.0	32*	1.73	4.25	15.4	444.3	5332

* Submerged Weir

STORCH ENGINEERS

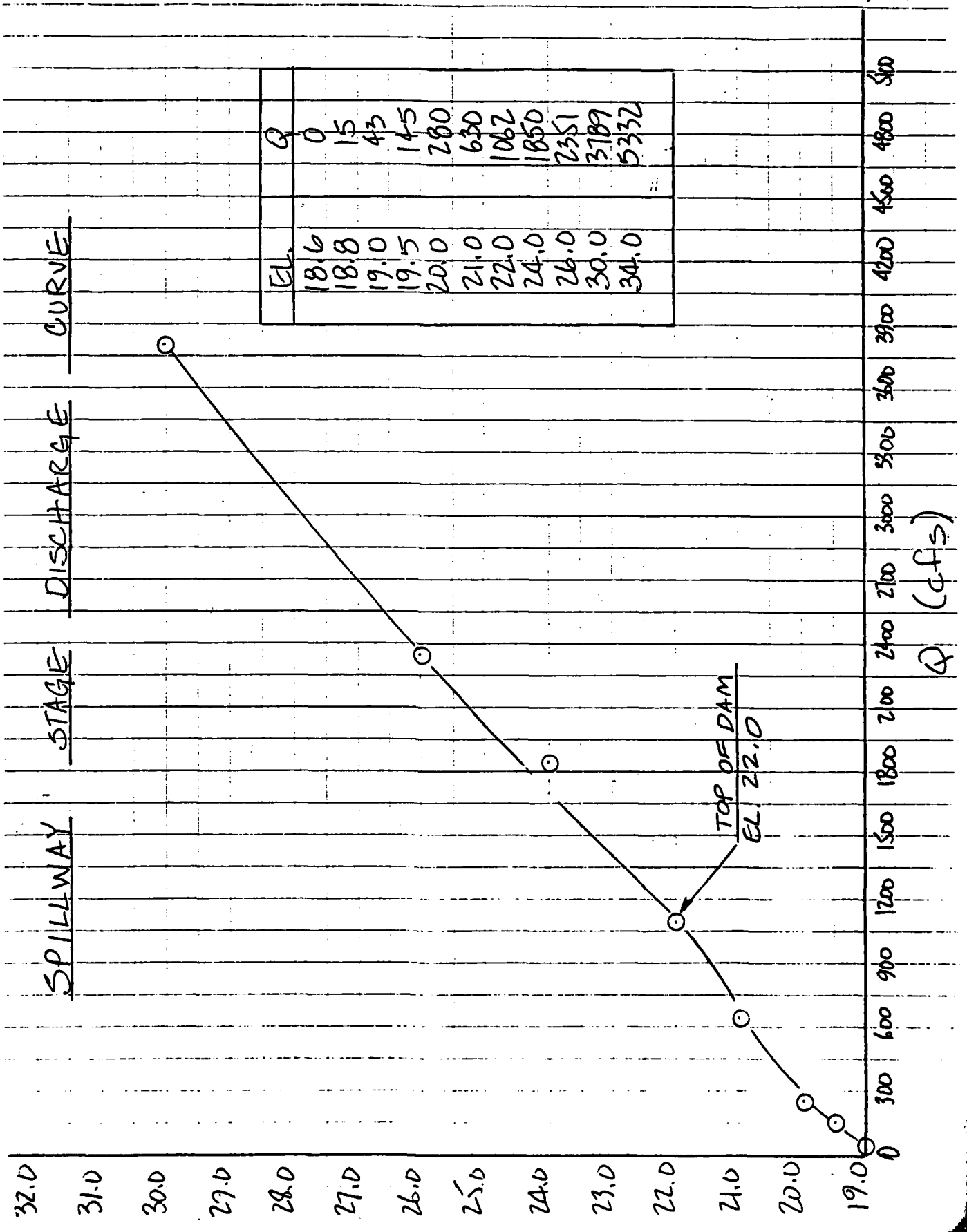
Project SMITHVILLE DAM

Sheet 8 of 9

Made By JLP Date 4-6-81

Chkd By JG Date 4/10/81

Q	EL.
0	18.6
15	18.8
43	19.0
145	19.5
280	20.0
630	21.0
1062	22.0
1850	24.0
2351	26.0
3789	30.0
5332	34.0



STORCH ENGINEERS

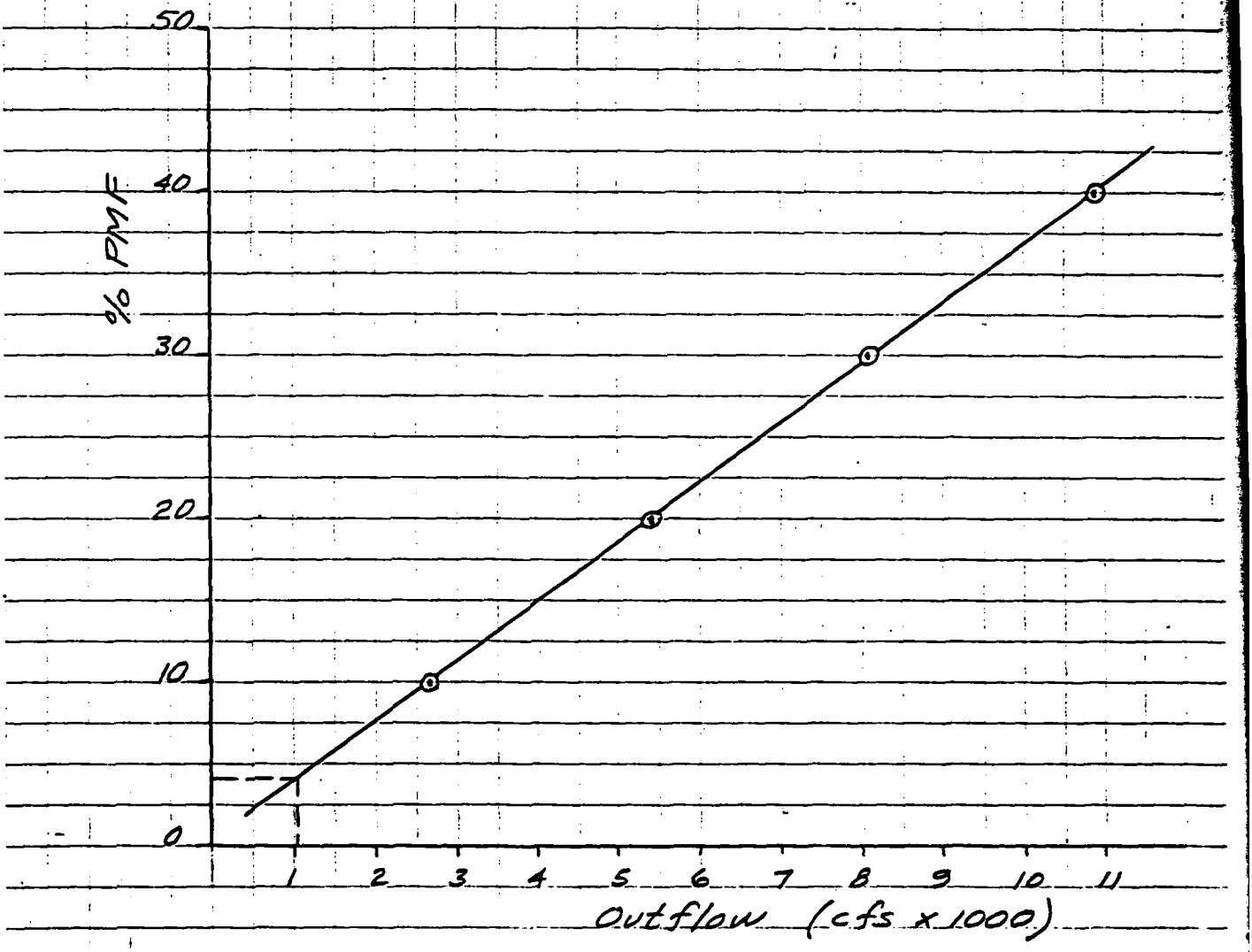
Sheet 9 of 9

Project Smithville Dam

Made By JG Date 4/10/81

Chkd By Date

OVERTOPPING POTENTIAL



Overtopping of dam occurs at elev. 22.0 with discharge Q = 1062 c.f.s.

Dam can pass approx. 4 % PMF

HEC - 1 - DAM PRINTOUT

Overtopping Analysis

```
1A1                          NATIONAL DAM SAFETY PROGRAM
A2                           SMITHVILLE DAM, NEW JERSEY
A3                           MULTI RATIO ROUTING
B     300        1         0                              0       0       4
R1      5
J       1        5         1
J1    0.5      0.4       0.3       0.2       0.1
K       0   LAKE                      0       0       1
K1          INFLOW HYDROGRAPH TO SMITHVILLE LAKE DAM
M       1        0       132               132       0                       1
P       0       27        77        84      93
T                                                  1.5    0.15
U    17.7     45.8         0
X    -1.0    -0.05       2.0
K       1   DAM                   0       0       1
K1          ROUTE DISCHARGE THRU DAM
Y                                 1       1
Y1      1                                          -18.6      -1
Y4   18.6     18.8      19.0      19.5    20.0    21.0    22.0    24.0    26.0    30.0
Y5      0       15        43       145     280     630    1062    1850    2351    3789
$A      0     36.7     192.8     495.8
$E   13.3     18.6      30.0      40.0
$$   18.6
$D   22.0     2.63       1.5       500
```

NATIONAL DAM SAFETY PROGRAM
SMITHVILLE DAM, NEW JERSEY
MULTI RATIO ROUTING

JOB SPECIFICATION

NO	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
300	1	0	0	0	0	0	0	4	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 5 LRTIO= 1

RTIOS= .50 .40 .30 .20 .10

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH TO SMITHVILLE LAKE DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
LAKE	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	0	132.00	0.00	132.00	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	27.00	77.00	84.00	93.00	0.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .873

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSNX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.50	.15	0.00	0.00

UNIT HYDROGRAPH DATA
TC= 17.70 R= 45.80 NTA= 0

RECESSION DATA
STRTQ= -1.00 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH 100 END-OF-PERIOD ORDINATES, LAG= 17.68 HOURS, CP= .31 VOL= .86

17.	66.	138.	226.	325.	435.	554.	680.	814.	947.
1072.	1184.	1284.	1369.	1440.	1495.	1530.	1535.	1512.	1460.
1448.	1417.	1386.	1356.	1327.	1298.	1270.	1243.	1216.	1190.
1164.	1139.	1114.	1090.	1066.	1043.	1021.	999.	977.	956.
936.	915.	896.	876.	857.	839.	821.	803.	786.	769.
752.	736.	720.	704.	689.	674.	660.	645.	631.	618.
605.	591.	579.	566.	554.	542.	530.	519.	508.	497.
486.	475.	465.	455.	445.	436.	426.	417.	408.	399.
391.	382.	374.	366.	358.	350.	343.	335.	328.	321.
314.	307.	301.	294.	288.	282.	275.	269.	264.	258.

END-OF-PERIOD FLOW

0											
MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q

SUM	21.93	18.09	3.85	1348301.
	(557.)	(459.)	(98.)	(38179.63)

HYDROGRAPH ROUTING

ROUTE DISCHARGE THRU DAM

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
DAM	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-19.	-1

STAGE	18.60	18.80	19.00	19.50	20.00	21.00	22.00	24.00	26.00	30.00
FLOW	0.00	15.00	43.00	145.00	280.00	630.00	1062.00	1850.00	2351.00	3789.00
SURFACE AREA=	0.	37.	193.	496.						
CAPACITY=	0.	65.	1257.	4583.						
ELEVATION=	13.	19.	30.	40.						

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
18.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
22.0	2.6	1.5	500.

PEAK OUTFLOW IS 13589. AT TIME 33.00 HOURS

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .50	RATIO 2 .40	RATIO 3 .30	RATIO 4 .20	RATIO 5 .10
HYDROGRAPH AT	LAKE	132.00	1	13592.	10873.	8155.	5437.	2718.
		(341.88)		(384.87)(	307.90)(	230.92)(	153.95)(	76.97)(
ROUTED TO	DAM	132.00	1	13589.	10871.	8153.	5435.	2716.
		(341.88)		(384.81)(	307.83)(	230.86)(	153.91)(	76.92)(
ROUTED TO	1	132.00	1	13581.	10863.	8146.	5428.	2712.
		(341.88)		(384.58)(	307.61)(	230.68)(	153.72)(	76.79)(

1 SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	18.60	18.60	22.00
STORAGE	65.	65.	244.
OUTFLOW	0.	0.	1062.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	26.17	4.17	649.	13589.	98.00	33.00	0.00
.40	25.51	3.51	569.	10871.	97.00	33.00	0.00
.30	24.78	2.78	488.	8153.	96.00	33.00	0.00
.20	23.96	1.96	405.	5435.	89.00	33.00	0.00
.10	22.98	.98	318.	2716.	55.00	33.00	0.00

APPENDIX 5

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